N° 17,884 A.D. 1905

Date of Application, 4th Sept., 1905—Accepted, 25th Jan., 1906

COMPLETE SPECIFICATION.

Improvements in or relating to Portable Storage Vessels for Liquefied Gases.

I, PAULUS HEYLANDT, of 65 Karthäusergasse, Erfurt, in the Empire of Germany, Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:

My invention relates to improvements in portable storage vessels for liquefied gases, such as air, oxygen, nitrogen *etc.*, whereby these portable storage vessels are enabled to preserve the liquefied gases for a longer time than hitherto, and they are also rendered more durable and even capable of withstanding the strains produced by shocks or jerks on a transport either by rail or by mail carriage without being damaged or losing their contents by vaporization. They may even be left without any superintendence during the transit, which hitherto was not permitted.

There are known metal storage vessels comprising external and internal vessels, so that spaces of a nearly uniform thickness are formed between them and from which the air has been pumped out, so as to reduce the transmission of heat from without to the internal vessels by means of the rarefied air. Experience, however, has shown, that the temperature of the ambient air transmitted to the liquefied gases by the conduction of the necks and the walls of the internal vessels contributes to the vaporization of the gases.

One of the improvements according to my invention consists in making the internal vessels of the above mentioned storage vessels from a material, which is not only a bad heat conductor but is also air-tight, solid and highly unsusceptible of very considerable changes of temperature. Such a material is for instance porcelain. Glass, on the contrary although a heat non-conducting material like porcelain, would be quite useless for the above purpose, since it is apt to break when in contact with liquefied air of about minus 200° Centigrade.

A further improvement consists in the manufacture of both the external and the internal vessels from the same material mentioned before. Thereby the vacuum in the space between the external and the internal vessels is preserved with a greater certainty and also their manufacture is simplified.

It is essential, that a good vacuum be maintained in the said space, this vacuum being nearly absolute, which will last for a number of months. Preferably the surfaces within the said space, that is to say the outside of the internal vessel and the inside of the external vessel, are made smooth and are brightened or polished in any known manner.

Owing to the very low point of ebullition of most liquefied gases, such as air, oxygen, hydrogen, nitrogen *etc.*, a small quantity of the gas will continuously vaporise and hence a certain pressure will be produced, so that it is not possible to conserve such liquefied gases in perfectly closed vessels. For this reason the internal vessel of each storage vessel is provided with an upwardly diverging neck, in which a stopper of loose or porous material is disposed. It is further absolutely necessary, that the neck with the loose or porous stopper should always remain at the top to enable the vaporised gas to escape through the pores of the stopper and to prevent the liquefied gas from flowing off in case the mouth of the neck is at a point beneath the level. The vaporised gas above the level having a greater specific weight than the ambient air will then

[*Price* 8*d.*]

be able to check the admission of the air. To ensure this isolation of the storage vessel by the vaporised gas and thereby the preservation of the liquefied gas for a longer time, it is necessary to provide means for keeping the neck of the internal vessel and the stopper in the vertical position.

A further improvement serves this purpose and consists in so suspending the storage vessel in a frame movable in all directions within a protecting vessel, that the mere weight of the storage vessel and that of the liquefied gas tends to bring the neck into a vertical position in spite of any inclination of the protecting vessel.

A further improvement consists in making this in all directions movable frame elastic for protecting the storage vessel from all shocks or jerks.

I will now proceed to describe my invention with reference to the accompanying drawings, in which—

Fig. 1 is a horizontal central section through a portable storage vessel and a protecting vessel, the internal vessel of the former being alone made of porcelain or the like,

Fig. 2 is a vertical central section through the same,

Fig. 3 is a similar vertical section, in which both the internal and the external vessels of the storage vessel are made of porcelain or the like,

Fig. 4 is a vertical central section through a portable protecting vessel and an elevation of a storage vessel, supported therein by means of a modified movable frame.

Fig. 5 is the plan of the modified movable frame in the same, and

Fig. 6 is a vertical central section on an enlarged scale through the top part of a modified storage vessel.

The globe-shaped storage vessel shown at Figs. 1 and 2 comprises an internal vessel 1 with an upwardly diverging neck 2 made of porcelain or a similar material and an external vessel 3 made of a metal. The internal vessel 1 with the neck 2 is made as thin as possible. The external vessel 3 is equally made as thin as possible and is preferably made in halves for the introduction of the internal vessel 1. The upper half of the external vessel 3 is provided with a dome 4 for surrounding the neck 2 and with an inward flange 5 for supporting the internal vessel 1. The outside of the internal vessel 1 and the neck 2 and the insides of the halves of the external vessel 3 are preferably made smooth and polished in any known manner. The neck 2 is then introduced through the flange 5, so as to project above the latter, and a two-part conical ring 6 of brass or other metal is put round the top of the neck 2 and is thereon cemented with a mass (for example Chatterton compound), which is air-tight and packs well even under great differences in temperatures. Thereupon the top of the neck 2 with the ring 6 is pushed into the flange 5 and this ring 6 is soldered on the flange 5, after which the halves of the external vessel are soldered together. Thus a space 19 of a nearly uniform thickness will be formed throughout between the two vessels 1 and 3, also the neck 2 and the dome 4. From this space 19 the air is pumped out in any known manner. It is obvious, that the conical ring 6 requires to be made in halves, as otherwise it could not be placed on the conical neck 2. Preferably a metallic cap 8 of a substantially conical shape and provided with a central tubular opening as shown in Figure 3 is put over the mouth of the neck 2 and is soldered with its edge on the dome 4. Thereby the joint between the flange 5 and the neck 2 is put out of the reach of the ambient air and its upper surface is protected. By this cap also the neck 2 is made to end conically within and without. The cap 8 may be made of German silver or the like. Two wires 9, 9 bent in the manner shown in Figures 1 and 2 and formed to two trunnions 10, 10 are soldered on the external metal vessel 3. The two trunnions are placed in a horizontal axis at a convenient point above the centre of the two vessels 1 and 3, so that when they are made to turn in two loops shown of the wire ring 11, the own weight of the two vessels 1 and 3 will invariably bring the neck 2 into a vertical plane,

since the centre of gravity of the whole is below the said horizontal axis. The ring 11 in turn is made to turn on two pins 12, 12 at right angles to the axis of the two pins 10, 10. Thus a frame is formed of the parts 9, 9, 10, 10, 11 and 12, 12, in which the storage vessel 1, 3 is movable in all directions, so that its own weight will bring the neck 2 into a vertical position, no matter whether all the four trunnions 10, 10 and 12, 12 are in the same horizontal plane or not. The protecting vessel is shown as consisting of a cylindrical part 13, a bottom 14 and a conical top 15 to which latter a cover 16 is hinged. The two pins 12, 12 mentioned above are fastened on the inside of the cylindrical part 13 and made to engage in the corresponding loops of the ring 11 in any known manner. For example the cylindrical part 13 provided with the two pins 12, 12 may be first so pressed on the front and on the rear in Fig. 2, as to make it oval, so that the two pins 12, 12 are moved a little away from each other. The storage vessel being temporarily placed on some convenient support, the cylindrical part 13 so pressed is put over it, until the two pins 12, 12 can engage in the loops of the ring 11, when the cylindrical part 13 is released and the two pins 12, 12 engage in the said loops. Then the bottom 14 is introduced into the cylindrical part 13 from below and is soldered thereon, after which the conical top 15 is introduced from above into the cylindrical part 13 and is soldered thereon. Now the whole will be ready for use. In case the weight of the portable storage vessel is not great, a single turnable handle 17 above the cover 16 will be sufficient for carrying the whole about. If, however, the weight is great, two or more lateral handles 18, 18 will be necessary.

The portable storage vessel is operated in the following manner:

After opening the cover 16 the liquefied gas is in a known manner introduced into the internal vessel 1 through a tube placed in the neck 2 and then a stopper 7 of a loose or porous material, such as cotton-wool, felt or the like, is put in the opening of the cap 8 and the cover 16 is closed. As the material of the internal vessel 1 and the neck 2 is a bad heat conductor and the transmission of heat from without through the nearly absolute vacuum in the space 19 is very slow, it follows, that the gas will remain in its liquefied state for a longer time, than hitherto. Should at last a certain small quantity of the same have vaporised and a certain small overpressure thereby be produced, the pores of the stopper 7 will allow the excess of the vaporised gas to escape into the space between the external vessel 3 and the protecting vessel. There the gas will expand and produce an intense cold, until it escapes through the slit between the cover 16 and the conical top 15.

When the liquefied gas is required for use, the cover 16 is opened, the stopper 7 is removed and a device of any known construction is introduced into the neck 2, after which the liquefied gas can be extracted as usual.

It is evident, that the parts 9, 10, 9, 10 and 11 of the elastic frame require to be made so strong as to be able to carry the weight of the storage vessel filled with liquefied gas and to sustain the strains caused by shocks or jerks. This frame is to prevent the storage vessel from striking the walls or the bottom of the protecting vessel. The storage vessel being thus elastically suspended in this frame, the vaporisation of the liquefied gas during the transit will be retarded.

Fig. 3 shows a storage vessel, the external and the internal vessels of which are both made from the same material, *i.e* porcelain or the like, and united in any known manner. As it is not possible to solder wires on the external vessel 3, the latter is provided with two opposite eyes 20, through which the lower ends of the wires 9 are passed, before they are bent, as is shown in Fig. 3. The two eyes 20 are oppositely inclined to prevent the storage vessel from jumping or shifting on the wires 9 under the action of shocks or jerks.

For pumping the air out of the space 19 a small pipe 21 of glass with a conical end is ground into a corresponding hole in the external vessel 3 and put in

communication with the respective air pump. After the evacuation of the space 19 this pipe 21 is closed by melting.

The protecting cap 8 of German silver or the like is in this case simply pinched into the neck 2.

Where so preferred, the two eyes 20 on the external vessel 3 may be omitted and the two bent wires 9, 9 may be replaced by a bow 22, which passes beneath the vessel 3 and is prevented from shifting by another elastic bow 23 at right angles to it, see Fig. 4. The elastic bow 23 extending beyond the central horizontal plane of the vessel 3 will grasp the latter. Or two crossing bows 23, 23 as shown in Fig. 5 may be used for preventing the bow 22 from shifting, the three bows being united in the crossing point by means of a solder or rivet or the like. The number of the wire bows 23 may be increased or these wires may be replaced by an equivalent means, such as a cage or the like.

It is evident, that as both the external vessel 3 and the internal vessel 1 are made of porcelain or the like, *i.e.* a heat non-conducting material, this storage vessel will present the advantage, that the vacuum will be longer preserved than before.

The internal vessel 1 shown in Fig. 2 may be modified in that the top edge of the neck 2 is bent outwardly and downwardly in the manner shown at Fig. 6. Thereby the joint is put out of the direct reach of the intense cold.

The movable suspension frame presents also the advantage, that a very simple stopper 7 of loose material may be used with safety and that a spring-pressed safety valve, which is necessary with known storage vessels, is rendered unnecessary, so that the construction of the whole is simplified.

The portable storage vessel may be varied in many respects without deviating from the spirit of my invention. The elastic frame movable in all directions may be made of rods of any cross section or of other equivalent parts. The construction of the protecting vessel is immaterial, the essential point being, that the frame movable in all directions be arranged within it.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:

1. A portable storage vessel for liquefied gases comprising an external vessel and an internal vessel, the former enclosing the latter with a vacuum space of a nearly uniform thickness between them, and a protecting vessel, characterized in that the internal vessel provided with an upwardly diverging neck is made as thin as possible and of a material which is not only a bad heat conductor but is also air-tight, solid and unsusceptible of changes of temperature, such as porcelain or the like, further that the top edge of its neck is surrounded with a metallic ring (made in halves) cemented with a mass unsusceptible of cold, and that the external vessel is made equally as thin as possible and of metal and is soldered on said metallic ring, for the purpose of obtaining as high a vacuum as possible, substantially as set forth.

2. A modification of the portable storage vessel according to Claim 1, characterized in that both the external vessel and the internal vessel are made of porcelain or a similar material and in one piece and that the vacuum is obtained by means of a small glass pipe, which is ground into the external vessel and closed by melting, substantially as set forth.

3. A portable storage vessel according to Claim 1 or 2, characterized in that the external vessel is so supported by an elastic frame movable in all directions within the protecting vessel, that the own weight of the external and internal vessels and that of the liquefied gas maintains the neck in its vertical position in spite of any accidental inclination of the protecting vessel, substantially as set forth.

4. A portable storage vessel according to Claim 3, characterized in that the movable frame consists of two trunnions secured in a horizontal axis within

the protecting vessel, a ring mounted to rock on said two trunnions and two elastic trunnions secured on the external vessel and mounted to rock in said ring around an axis at right angles to that of said two trunnions, substantially as set forth.

5. A portable storage vessel according to Claims 3 and 4, characterized in that the neck of the storage vessel proper is closed with a metallic cap having a central tubular opening and a stopper of loose or porous material, for the purpose of rendering any spring-pressed safety valve unnecessary, substantially as set forth.

6. A portable storage vessel according to Claim 1, characterized in that the top edge of the neck is bent outwardly and downwardly, for the purpose of bringing the joint out of the direct reach of the cold, substantially as set forth.

7. In a portable storage vessel for liquefied gases, the whole constructed, arranged and adapted to operate, substantially as herein shown and described with reference to Figs. 1 and 2.

8. In a portable storage vessel for liquefied gases, the whole constructed, arranged and adapted to operate, substantially as herein shown and described with reference to Fig. 3.

Dated this 4th day of September 1905.

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101 Colmore Row, Birmingham,
Agents for the Applicant.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1906.

Fig.1.

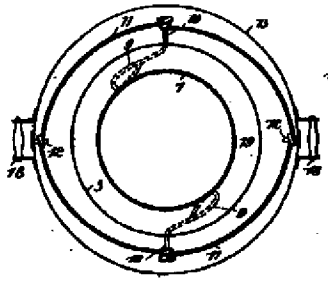

Fig.2.

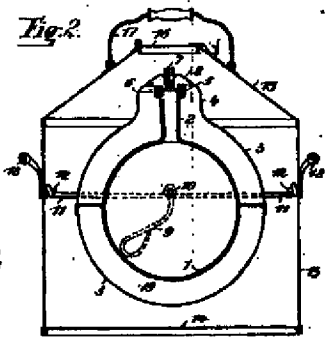

Fig.3.

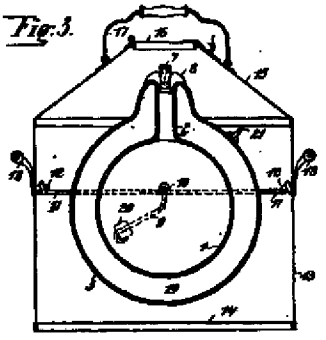

Fig.5.

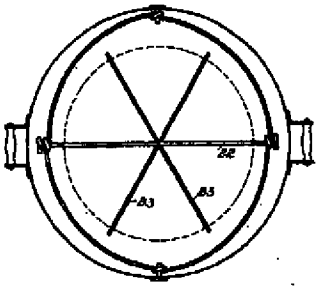

Fig.4.

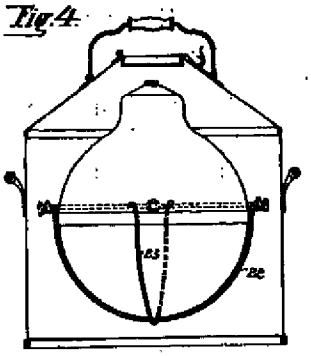

Fig.6.

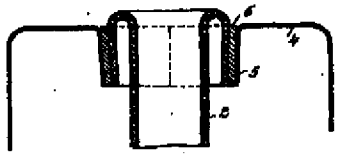

Fig.1.

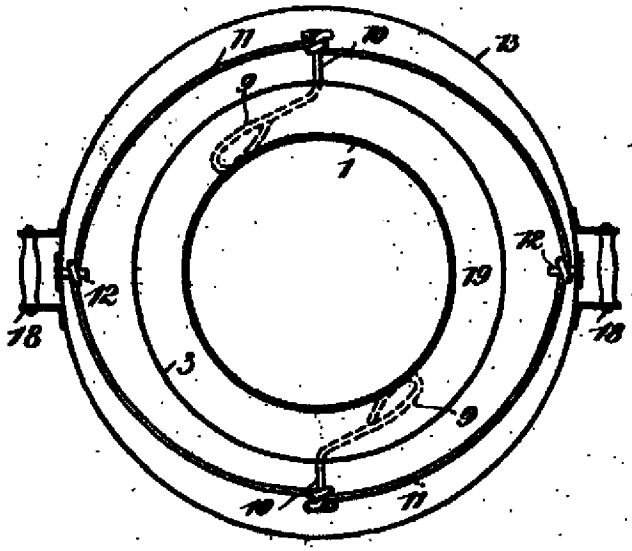

Fig.2.

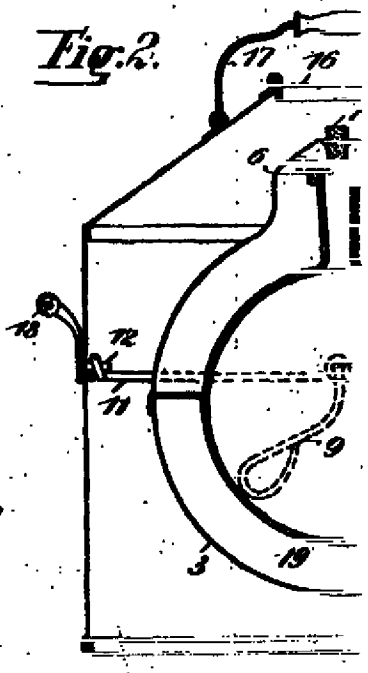

Fig.5.

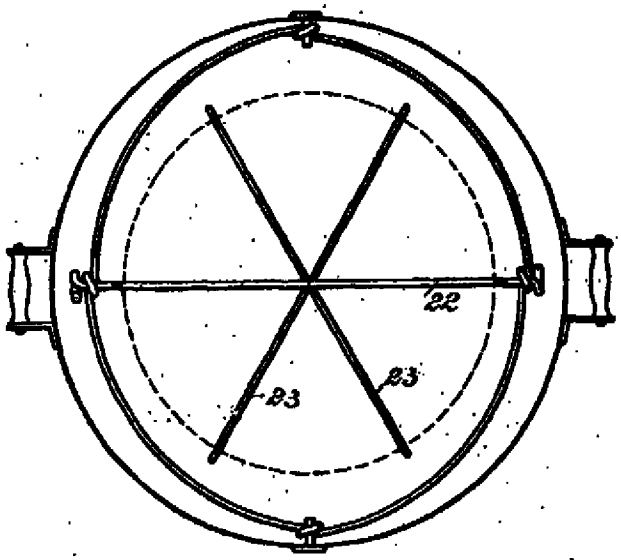

Fig.4.

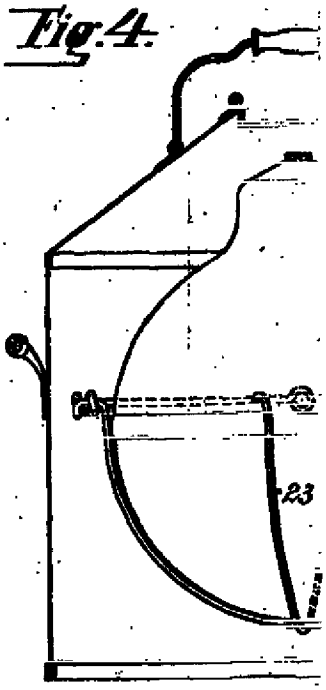

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Fig. 3.

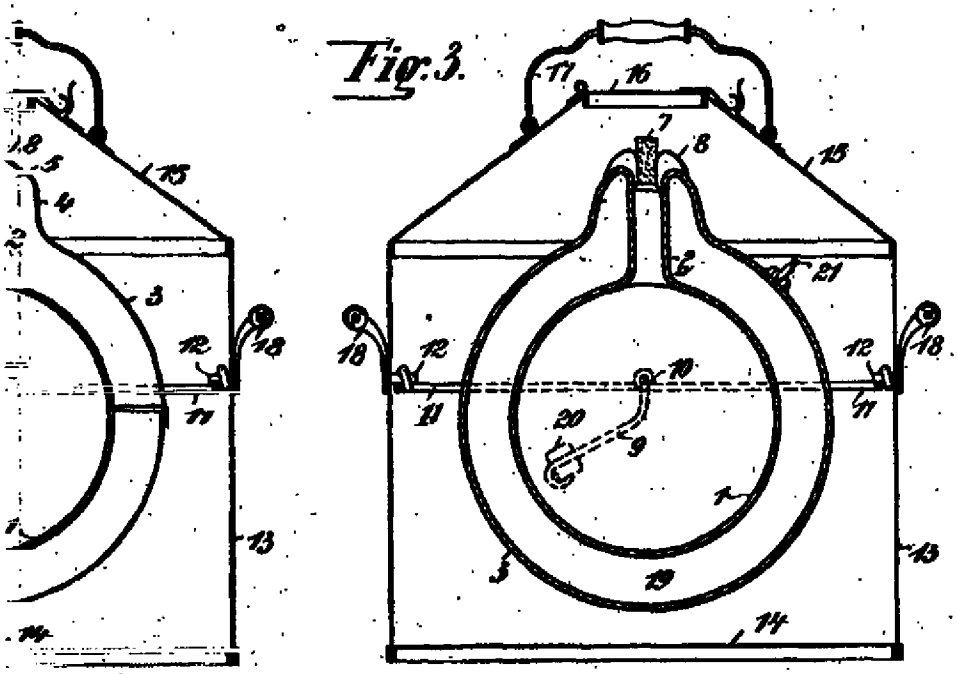
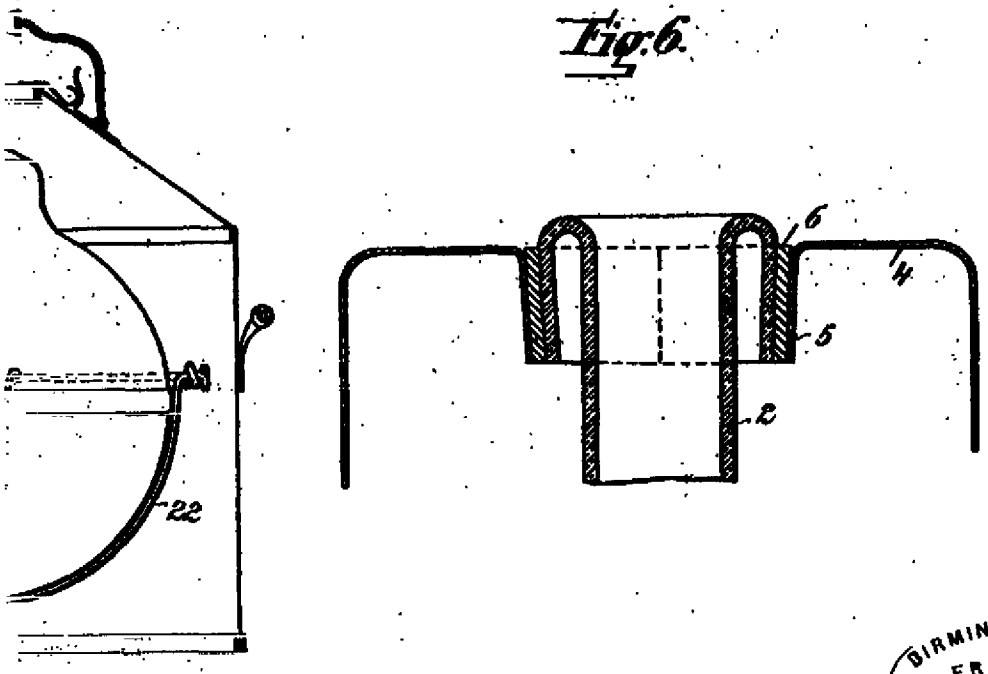


Fig. 6.



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